

Tennessee Department of Transportation Division of Materials and Tests

Submittal and Approval of Concrete Mixture Designs (SOP 4-4)

Purpose: The purpose of this document is to establish a submittal and approval process for all concrete mixtures including ready mix, prestressed, and precast concrete.

Discussion: Concrete mixture designs submitted to TDOT for approval must exhibit certain physical performance properties indicated in TDOT Standard Specifications including but not limited to slump, air content, temperature, unit weight, and yield; the hardened concrete must meet compressive strength requirements.

The contractor shall first determine from the Plans the class of concrete required along with the design criteria for the mix (i.e. a project-specific requirement of 3000 psi in 18 hours).

Procedure: A new concrete mix design shall be subject to the following procedures prior to being approved for use in TDOT work:

A Concrete Mix Design Technician (Level 3) or a registered civil engineer licensed by the state of Tennessee shall determine, by using volumetric mix design procedures, the proportions of all materials in the mix in accordance with TDOT Standard Specifications 501.03(A), 604.03(A), 615.09, and SOP 5-3 (Manufacture and Acceptance of Precast Drainage Structures, Noise Wall Panels, and Earth Retaining Wall Products) Section 5.0.

A trial batch shall be mixed according to those proportions, including appropriate admixtures, and the tests for the freshly-mixed concrete shall be conducted to determine the actual slump, temperature, air content, unit weight, and yield. The hardened specimens, after proper curing, shall then be tested for compressive strength. **Any trial batch mixed for Class SCC, P-SCC, and SH-SCC shall be verified in the presence of Regional Materials and Tests per TDOT Standard Specifications 604.03(A) and 615.09.**

If all test results meet the required design criteria, the design must be submitted to Headquarters Materials and Tests no less than 14 working days prior to mix production. New design submittals must be listed on the [Concrete Mix Design Template](#). Designs to be associated to another contract must be listed on the [Concrete Design Contract Association Request Form](#), have been used on a TDOT funded project within the previous 6 months, and have passing test results. New or existing designs shall be emailed to concrete.mixdesign@tn.gov.

Email subject lines must state whether the design is a new or existing design along with the contract number. Any submitted mix designs intended to be used for riding surfaces requiring the use of surface aggregate materials, **e.g., Class**

CP, Class DS, and Class A Paving (Modified), should include “Surface Aggregates Required” in the body of the email.

Materials: Cement: The source and location must be listed on the [Qualified Products List](#) (QPL 15) and meet the requirements outlined in Section 901.01 of the TDOT Standard Specifications. Any change of cement shall require a new submittal, including a new trial batch complete with test results.

Fly Ash: The source and location must be listed on the Qualified Products List (QPL 16) and meet the requirements outlined in Section 921.15 of the TDOT Standard Specifications. Any change of fly ash shall require a new submittal, including a new trial batch complete with test results, **with the exception of an emergency fly ash outage as specified below**. Fly ash replacement shall be in accordance with TDOT Standard Specifications 501.03(A) or 604.03(A).

In the event that a project may be delayed due to a fly ash outage, the source of fly ash may be changed to another approved fly ash source listed on QPL 16. A new mix design template worksheet shall be submitted to Headquarters Materials and Tests for review, but a new trial batch will not be required. In the body of the mix design submittal email, a detailed message of the substitution shall be provided. Upon review and approval, a new mix design number will be assigned to the new design with the substituted fly ash.

Ground Granulated Blast Furnace Slag (GGBFS): The source and location must be listed on the Qualified Products List (QPL 16) and meet the requirements outlined in Section 921.16 of the TDOT Standard Specifications. Any change of GGBFS shall require a new submittal, including a new trial batch complete with test results. GGBFS replacement shall be in accordance with TDOT Standard Specifications 501.03(A) or 604.03(A).

Silica Fume: The source and location must be listed on the Qualified Products List (QPL 16). Any change of silica fume shall require a new submittal, including a new trial batch complete with test results.

Water: Must be from an approved source; refer to TDOT Standard Specification 921.01. **Non-municipal water sources shall provide their most recent water results per Table 921.01-1 and 921.01-2 of the TDOT Standard Specification along with the mix design submittal package.**

Coarse Aggregate: The source and location must be from an approved source meeting quality test requirements outlined in Section 903.03 of the TDOT Standard Specifications. Gradation and specific gravity test results must be submitted reflecting the characteristics of the stockpile to be used in the mix.

Where approved surface aggregates are required as per TDOT Standard Specifications 903.03, coarse aggregates must meet the specifications stated in 903.24. The [TDOT Approved Surface Aggregates](#) list outlines all of the approved sources.

In the event that a project may be delayed due to an insufficient supply of coarse aggregate, the source of aggregate may be changed to another approved source of like material (e.g. limestone for limestone, or granite for granite) provided the specific gravity of the new material is within 0.15 of the original material.

Fine Aggregate: The source and location must be from an approved source meeting quality test requirements outlined in Section 903.01 of the TDOT Standard Specifications and AASHTO M-6. Gradation, fineness modulus, and specific gravity test results must be submitted reflecting the characteristics of the stockpile to be used in the mix.

Any change of fine aggregate shall require a new submittal, including a new trial batch complete with test results. Manufactured sand shall not be used in mixes designed as surface courses.

Chemical Admixtures including Air-Entraining Admixtures: All admixtures must be listed on the Qualified Products List (QPL 4) and, in a given mix, must all be supplied by the same manufacturer. **Admixture dosage rates (oz/cwt) used in the trial batch shall be submitted on the Concrete Mix Design Template for all SCC and High Early Strength concrete designs.** A change in admixture dosage rate may be allowed at the discretion of the project supervisor to adjust the physical characteristics of the concrete (workability, for example).

Distribution:

Once the submittal is approved, the design will be distributed as follows:

- A copy is sent to HQ Materials and Tests Administrative Section. Administration sends an official copy to the project file.
- Regional Materials and Tests and the producer will receive an electronic copy.
- Regional Materials and Tests will forward copies to the Project Supervisor; the Project Supervisor will ensure that the Project Inspector receives a copy

The [Concrete Mix Design Submittal and Approval Process Flowchart](#) illustrates the distribution of an approved concrete mix design.

Further Guidance:

Once approved, the mix design will be valid for any other State project provided that the test results, including compressive strength, are satisfactory and within allowable tolerances. Acceptance and quality control (QC) testing shall be conducted in accordance with SOP 1-1.

There is a maximum of 3 approved concrete designs of each class per project per producer unless authorized by the Materials Engineer. The approved mix design shall expire after 6 months if it is not used on a TDOT funded project or does not meet the minimum 28 day strength requirements.